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ARTICLE VII.

*Observations on the Storm of December 15, 1839. By William C. Redfield, A. M.
Read January 15, 1841.*

IN the table and map which are annexed to these remarks will be found the observations which have been obtained of the direction of wind in this storm, in the states of Connecticut, Rhode Island, Massachusetts, New Jersey, and parts of the states of Maine, New Hampshire, Vermont, and New York.

The arrows on the map denote, approximately, the direction of wind, at or near the hour of noon, at the several places of observation. The concentric lines, drawn at intervals of thirty miles, were added, not as precisely indicating the true course of the wind, but to afford better means of comparison for the several observations.

It will be seen, that of forty-eight distinct sets of observations, which are comprised in the annexed schedule, about thirty are derived from the meteorological journals of scientific and intelligent observers, or from the log-books of vessels exposed to the storm. And I take this occasion to offer my thanks to the gentlemen who have so kindly furnished me with their observations.

The position assumed for the axis of the gale, at noon, should, perhaps, be nearly in line with the position of the ship Morrison and Cape Cod Bay; at which places the wind was then blowing from opposite points of the compass, but not in actually opposing directions. The Morrison was from China, bound to New York; and I have reason to believe that her position at noon may be safely relied on. The violence of the gale was here so great that the ship, as I am informed, was lying to without canvass. This ship had encountered the

western side of the gale, suddenly, at 7, A. M., and the sun shone chiefly unobscured during the greater part of the day.

The gale was severe over the entire surface comprised in the map, except, perhaps, on its extreme northern and north-western portions, and excepting, also, the lighter winds which were observed near the apparent axis of the gale, in the region of Buzzards' and Cape Cod Bays, &c., in the afternoon and evening. A very heavy fall of snow accompanied the gale in the states of Connecticut, Rhode Island, Massachusetts, New Hampshire, and Maine; also, in some parts of New York and southern Vermont. Some snow also fell in the western and northern parts of New York and Vermont, but attended with more moderate and variable winds, chiefly from the north and west.

The south-westerly and southerly winds, which connect the south-easterly with the westerly winds in the circuit of rotation, are found at Nantucket in the afternoon, by the farther advance of the storm, and also in the log-books of a number of vessels whose positions were eastward and southward of the ship Morrison, but beyond the limits of the map.

The barometric minimum, as in other storms, appears to have nearly coincided, in its progress, with the apparent axis of the gale.

My main object in collecting the observations contained in the subjoined schedule has been to establish the course of the wind in the body or heart of the storm at a given time, and apart from all other considerations. I am in possession, however, of more extended observations of this gale. Many of these appear to agree with some of the following characters or modes of action which pertain, more or less, to many of the storms or gales that visit the United States and other regions. These characters have claimed attention from almost the earliest period of my inquiries.

1. The body of the gale usually comprises an area of rain or foul weather, together with another, and perhaps equal, or greater area of fair or bright weather.

2. The fall of rain or snow often extends, in some direction, greatly beyond the observed limits of the gale.

3. The gale itself not unfrequently exhibits an apparently unequal extent of action, or degree of violence, on different sides of its apparent axis of rotation.

This peculiarity, as well as the second, is most common in winter storms, and in those which sweep over an extensive continental surface; and, like other

irregularities, is less noticeable in the storms which are traced solely on the ocean.

4. The barometric indications of a gale commonly extend much beyond the observed limits of its action.

5. The body of the gale constitutes a determinate sheet or stratum of moving air; and of this sheet or stratum a large portion sometimes overlies another and more quiescent stratum of air, the latter having, perhaps, a different motion; as in common winds of the temperate and higher latitudes: in which case the gale is either not felt at the surface of the earth, or the observed changes of wind are found, in part, unconformable to the whirlwind theory.

6. Owing to the convergent and somewhat variable courses of storms in the extra tropical latitudes, as well as to their unequal rates of progress, two storms will sometimes cover, in part, the same field, one of which will overlie the other, and, perhaps, thin out at its margin, in the same manner as common winds. This, also, may occasion a different order of change in the observed winds and weather from that which is more commonly noticed in a regular whirlwind storm.

Owing to such causes, the oscillations of the barometer are often irregular; and this is particularly noticeable in the higher latitudes.

7. In most gales of wind there is, probably, a subordinate motion, inclining gradually downward and inward in the circumjacent air, and in the lower portions of the gale; and a like degree of motion, spirally upward and outward, in the central and higher portions of the storm. This slight vorticular movement is believed to contribute largely to the clouds and rain which usually accompany a storm or gale; and is probably due, in part, to the excess of external atmospheric pressure on the outward portions of the revolving storm.

8. In storms which are greatly expanded there is sometimes found an extensive area of winds of little force and variable direction, lying within the circuit of the true gale, and attended throughout, with a depressed state of the barometer. This more quiescent portion of air in the centre of a gale has been found to extend, in some cases, to a diameter of several hundred miles.

In the case now before us, the direction of the arrows representing the course of the wind at noon, as carefully drawn on a larger map, shows an average convergence, or inward inclination, of about six degrees. But it is not deemed safe to rely upon this result in a single case, which is liable to be affected by

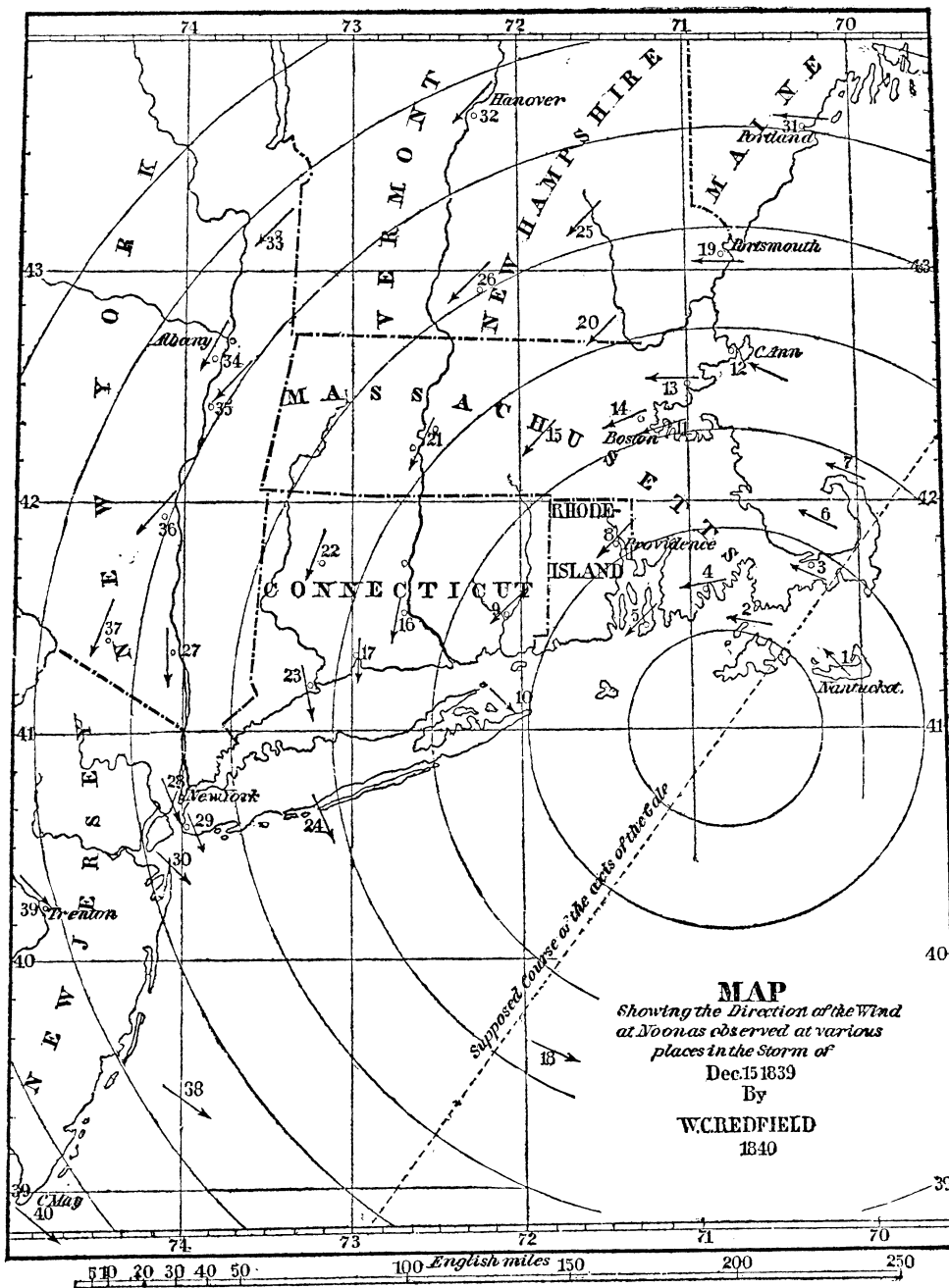
the errors of observation and the deflecting influences of the great valleys and lines of elevation, as well as by the errors of approximation which often arise from referring all winds to eight, or, at most, to sixteen points of the compass.

It is not intended, on this occasion, to support the foregoing characteristics by such extended details of evidence as their discussion would necessarily demand; and they are mentioned here only because the true character of the rotation in these gales, as well as the necessary or incidental connexion of this rotation with other phenomena which attend them, has seemed to be often misapprehended.

As relates to the whirling or rotary action in the case before us, it may be remarked, that had we obtained no observations from the north-western side of the axis of this gale, it would have been easy, in the absence of more strictly consecutive observations than are usually attainable, to have viewed the initial south-easterly wind of the gale,* and the strong north-westerly wind which soon followed, as two distinct sheets, or currents of wind, blowing in strictly opposing directions: and if we could so far lose sight of the conservation of spaces and areas, the laws of momentum and gravitation, together with a continually depressed barometer within the storm, we might then have supposed one of these great winds, if not both, to have been turned upward by an unseen deflection, and doubled back upon itself in the higher atmosphere. But the case neither calls for nor admits these speculations. If, however, the axis of this gale had chanced to pass westward and northward of our limits of correct observation, in pursuing its north-easterly course, as did, perhaps, that of the storm of December 21st, 1836, which has been ably examined and discussed by Professor Loomis,† it is, in such case, more than probable that its whirlwind character would not have been established.

* Observed between the coast of Massachusetts and latitude 25° N,

† Trans. Am. Phil. Soc., Vol. VII., p. 125—163.



Schedule of Observations on the Direction of Wind in the Storm of December 15th, 1839: With a Map indicating the Direction of the Wind at or near the hour of Noon. By WILLIAM C. REDFIELD.

No.	Places of Observation.	A. M.	Noon.	P. M.	Observers and Authorities.
1	Nantucket, Ms. . .	E. . .	S.E. at 1 p. m. .	S. W. .	Report of James Mitchell, as published by Mr. Espy. [Nantucket.
2	Woodville, Ms.	"A little S. of E."	Clouds broke at W. before 2 P. M.	Observations on board Steamboat Telegraph, by William Mitchell of
3	Barnstable, Ms. . .	N. E. at 7 a. m. .	} [E. S. E.] {	E. at 2 p. m.: S. E. at Sunset.	Report to Editor of Boston Courier. } <i>I take the mean of E. and S. E.</i>
	Do. . .	Gale from S. E. .		S.W. p. m.: Clear at Sunset.	Letter of Wm. H. Brown to W. C. R. } <i>for true direction at Noon. w. c. r.</i>
4	New Bedford, Ms	Sunrise, N. E. mod.	} [E. by N.] {	2 p. m. E. N. E.: 3½ p. m. S.	Joseph Congdon's Meteorological Journal. } <i>I take E. by N. as the mean</i>
	Do. . .	do. E. fresh,		do. E.: Sunset S S E	Sam'l Rodman's do. as publ'd by Mr. Espy. } <i>for Noon.</i>
5	Newport, R. I. . .	N. E. . .	N. E. . .	N. E. . .	Meteorological Journal published at Newport.
6	Cape Cod Bay, . .	E. S. E. . .	E. S. E. . .	E. S. E. at 2 p. m.	Report of Capt. Slemmer, Brig Columbus.
7	Provincetown, Ms.	E. S. E. . .	E. S. E. . .	E. S. E. . .	Marine Reports in Boston Newspapers.
8	Providence, R. I. .	N. E. . .	N. E. . .	N. E. . .	Professor Caswell's Meteorological Journal.
9	Norwich, Ct. . .	N. E. . .	N. E. . .	N. E. . .	Norwich Courier.
10	Culloden Point, N. Y.	"changed to	N. W. at Noon."	. . .	Capt. Green's Account, as published by Mr. Espy.
11	Boston, Ms. . .	Sunrise, N. E. .	E. N. E. } [E. 17° N.] {	Sunset, E. S. E. .	Wm. Cranch Bond's Meteorol. Journal. } <i>I take the mean of the observa-</i>
	Do. . .	E. by N. . .	E. by N. . .	E. by N. . .	Robert Treat Paine's Observations. } <i>tions at Noon.</i>
12	Gloucester, Ms. . .	E. S. E. . .	E. S. E. . .	E. S. E. . .	Letter from Gloucester, in the Boston Newspapers.
13	Salem, Ms. . .	Eastward. . .	Eastward. . .	Eastward. . .	Salem Gazette.
14	Waltham, Ms. . .	N. E. . .	[E. N. E.] . .	E. . .	Monthly Met. Jour., by C. F., in the Boston Daily Centinel.
15	Worcester, Ms. . .	N. E. . .	N. E. . .	N. E. . .	Met. Journal at State Lunatic Hospital—in National Ægis.
16	Middletown, Ct. . .	N. N. E. . .	} [N. by E.] {	N. . .	Reported by Professor Smith. } <i>I take N. by E. for the mean at Noon.</i>
	Do. . .	N. . .		N. N. E. . .	Dr. Barratt's Met. Journal. }
17	New Haven, Ct. . .	N. by W. . .	} [N. 3° E.] {	N. N. W. . .	Report of Capt. Woolsey, Steamboat Providence. } <i>I take the mean of</i>
	Do. . .	N. N. E. . .		N. N. E. till 1½ p. m.	Judge Darling's Meteorological Journal. } <i>N. 3° E.</i>
18	Ship Morrison, at sea: Lat. 39° 35' N. Lon. 71° 50' W.	S. E.: W. N. W.	W. N. W. . .	W. N. W. . .	Ship's Log Book—also, Statements of Capt. Benson and his Officers.
19	Portsmouth, N. H. .	E. . .	E. . .	E. . .	Weekly Meteorological Journal, published at Portsmouth.
20	Nashua, N. H. . .	N. E. . .	N. E. . .	N. E. . .	Nashua Telegraph.
21	{ Northampton, Ms. .	N. E. . .	} [N. N. E.] {	N. E. . .	Observations of W. Atwill and others. } <i>I assume the approximate mean</i>
	{ Amherst, Ms. . .	N. by W. . .		N. by W. . .	Professor Snell's Met. Journal. } <i>of N. N. E. for Noon.</i>
22	Litchfield, Ct. . .	Night of 14, 15, N. E	[N. N. E.] . .	N. at Night of 15th.	Litchfield Enquirer. Assumed mean for noon of 15th, N. N. E.
23	Stratford, Ct. . .	N. by W. . .	N. by W. . .	N. by W. . .	Rev. J. R. Linsley's Meteorological Journal.
24	Fire Island Beach, N. Y.	Midnight, N. E.: veered by N.	N. N. W. . .	N. N. W. . .	Captains Cartwright and Skiddy, employed at the Beach.
25	Concord, N. H. . .	Northeasterly. .	N. E. . .	N. E. and more N'ly	Letter from Concord to S. G. Arnold; from Mr. Arnold.
26	Keene, N. H. . .	N. E. . .	N. E. . .	N. E. . .	Rev. Z. S. Barstow's Meteorological Journal.
27	West Point, N. Y. .	N. . .	N. . .	N. . .	Meteorological Journal of the Medical Department.
28	New-York City, . .	N. by W.: N. N. W.	N. N. W. . .	N. W. by N. . .	Meteorological Journal of W. C. Redfield.
	Fort Wood, N. Y. Harbor	N. . .	[N. N. W.] . .	N. W. . .	Met. Journal of Medical Officer. Mean of N. N. W. taken for Noon.
29	Flatbush, N. Y. . .	N. . .	[N. N. W.] . .	N. W. . .	Rev. T. M. Strong's Met. Jour. Mean of N. N. W. assumed for Noon.
30	Sandy Hook Bay, N. Y.	N. . .	N. W. . .	N. W. . .	Log Book of Bark Osceola.
31	Portland, Me. . .	N. E.: at 11 E. .	[E. 6° S. mean.] .	E. by S. . .	Met. Report of Keeper of Marine Observatory: Published at Portland.
32	Hanover, N. H. . .	N. E. . .	[N. E.] . .	N. . .	Professor Young's Meteorological Journal.
33	Salem, N. Y. . .	N. E. . .	N. E. . .	N. E. . .	William Brand and W. Larkin; Meteorological Journal.
34	{ Albany, N. Y. . .	N. E. . .	} [N. 28° E.] {	N. E. . .	T. Romeyn Beck, M. D. Met. Journal } <i>Mean assumed for Noon,</i>
	{ Lansingburgh, N. Y. .	N. N. E. . .		N. . .	E. T. Foote, Meteorological Journal. } <i>N. 28° E.</i>
35	Kinderhook, N. Y. .	N. E. . .	N. E. . .	N. E. . .	Silas Metcalf, Meteorological Journal.
36	Kingston, N. Y. . .	N. E. . .	N. E. . .	N. E. . .	Isaac Blauvelt; Meteorological Journal. ~~~~~ [noon, N. N. E.]
37	Goshen, N. Y. . .	N. E. . .	[N. N. E.] . .	N. . .	Nathaniel Webb and John S. Crane; Met Jour. Mean assumed for
38	Bark Ann Louisa, off Ab-secom, N. J.	W. N. W. . .	N. W. . .	N. W. . .	Ship's Log Book, and Statement of Capt. Wilson.
39	Trenton, N. J. . .	N. W. . .	N. W. . .	N. W. . .	Dr. F. A. Ewing's Meteorological Journal.
40	Cape May, N. J. . .	N. W. . .	N. W. . .	N. W. . .	Marine Reports, and Letter from Cape May, in Philad. Newspapers.

* Abbreviations.—N. H. State of New Hampshire; Me. Maine; Ms. Massachusetts; R. I. Rhode Island; Ct. Connecticut; N. Y. New-York; N. J. New Jersey.—Note. My own observations on the 15th P. M. have on a former occasion been erroneously printed N. W. by W.; for which read N. W. by N.